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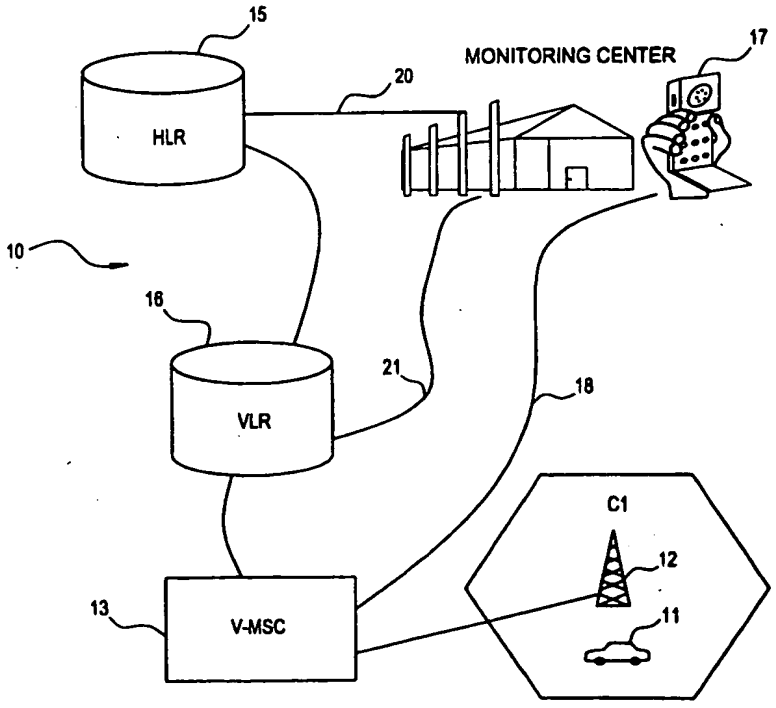
(54) Title: METHOD IN A RADIO TELECOMMUNICATIONS NETWORK OF PROVIDING SIGNAL STRENGTH AND MOBILE STATION INFORMATION TO A MONITORING AGENCY

(57) Abstract

A method of automatically providing information regarding a monitored mobile station (11) and subscriber to a monitoring center (17) in a cellular telecommunications network having a mobile switching center (MSC) (13), a home location register (HLR) (15), a base station (12) serving the monitored mobile station, and a plurality of neighboring base stations. The information includes one or more of the following: signal strength measurements (27), call–related information (51) from the MSC, and subscriber categories (61) from the HLR. The MSC automatically sends the information to the monitoring center at predetermined times. The information may be sent continuously as (33) it is received in the MSC, periodically (31) at predetermined time intervals, or when triggering events (35), such as a large change in signal strength or a handoff request by the monitored mobile station, are detected by the MSC. The information may be sent as a data printout or as a User Service Sigaling Data (USSD) or Short Message Service (SMS) message on the digital traffic channel (DTC) if the center is a mobile terminal or other terminal that has data messaging capabilities.



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METHOD IN A RADIO TELECOMMUNICATIONS NETWORK OF PROVIDING SIGNAL STRENGTH AND MOBILE STATION INFORMATION TO A MONITORING AGENCY

BACKGROUND OF THE INVENTION

Technical Field of the Invention

This invention relates to telecommunication systems and, more particularly, to a method in a radio telecommunications network of providing signal strength and mobile station information to a monitoring agency.

Description of Related Art

It is sometimes desirable for agencies such as law enforcement agencies to monitor telephone calls to or from a mobile station (MS) in a radio telecommunications network. It may also be desirable for the monitoring agency to obtain information regarding the signal strength of the MS, information about the subscriber's categories, or other call-related information. Today, if a MS is being monitored by a monitoring agency, the agency may obtain cell location and other call-related information by initiating an access to the serving mobile switching center (MSC) and querying the MSC for call data. While call-related information may be obtained during a call, to obtain signal strength information, the agency's monitoring center must wait until the call is completed and log files are generated. There is no process in existing networks for automatically providing a monitoring center with signal strength information for a monitored MS, or information about the subscriber's categories. Additionally, there is no process for automatically sending this information or other call-related information in a User Service Signaling Data (USSD) or Short Message Service (SMS) message to a monitoring center during a call in real time.

Although there are no known prior art teachings of a solution to the aforementioned deficiency and shortcoming such as that disclosed herein, there are a large number of patents which disclose methods of locating mobile stations in a radio telecommunications network. For example, U.S. Patent Number 5,564,079 to Olsson, U.S. Patent Number 5,406,275 to Hassett et al., U.S. Patent Number 5,293,642 to Lo,

U.S. Patent Number 5,208,756 to Song, and U.S. Patent Number 4,891,650 to Sheffer all disclose methods of locating mobile stations in a radio telecommunications network. However, no prior art references disclose a process of automatically providing information regarding the signal strength of a monitored MS, information about the subscriber's categories, or other call-related information to a monitoring center during a call in real-time.

In order to overcome the disadvantage of existing solutions, it would be advantageous to have a method of providing a monitoring center with signal strength information for a monitored MS, and information about the subscriber's categories. Additionally, the method would automatically send this information or other call-related information in a SMS message to the monitoring center during a call in real time, without having to wait until after the call is completed. The present invention provides such a method.

SUMMARY OF THE INVENTION

In one aspect, the present invention is a method of automatically providing to a monitoring center, signal strength measurements taken between a mobile station and a serving base station in a cellular telecommunications network. The method comprises the steps of measuring the signal strength between the mobile station and the serving base station, sending the signal strength measurements from the serving base station to a mobile switching center (MSC), and automatically sending the signal strength measurements from the MSC to the monitoring center at predetermined times.

In another aspect, the present invention is a method of automatically providing information regarding a monitored mobile station and subscriber to a monitoring center in a cellular telecommunications network having a mobile switching center (MSC), a home location register (HLR), a base station serving the monitored mobile station, and a plurality of neighboring base stations. The method begins by measuring in the serving base station, signal strength measurements between the mobile station and the serving base station, and sending the signal strength measurements from the serving base station to the MSC. Call-related information is also stored in the MSC, and at predetermined times, the method automatically sends the signal strength measurements and the call-related information from the MSC to the monitoring center.

Additionally, the method may include sending subscriber categories for the monitored subscriber from the HLR to the MSC, and automatically sending the subscriber categories from the MSC to the monitoring center at predetermined times.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and its numerous objects and advantages will become more apparent to those skilled in the art by reference to the following drawings, in conjunction with the accompanying specification, in which:

FIG. 1 is a simplified block diagram of a cellular telecommunications network in which the present invention has been implemented;

FIGS. 2A and 2B are a flow chart illustrating the steps of the preferred embodiment of the present invention;

FIG. 3 is a flow chart illustrating the steps of the method of the present invention when retrieving other call-related information from the MSC and sending the information to the monitoring center; and

FIGS. 4A-4C are a flow chart illustrating the steps of the method of the present invention when retrieving subscriber categories and sending the subscriber categories to the monitoring center.

DETAILED DESCRIPTION OF EMBODIMENTS

The present invention automatically provides signal strength measurements, subscriber categories, or other call-related information to a monitoring center during a call in real time. The monitoring agency does not have to wait until after the call is completed so that log files can be accessed. The information may be provided to the monitoring center continuously as the MSC receives it, periodically such as at registration, or when triggered by certain triggering events such as large or rapid changes in the attenuation of the signal strength. When utilizing a trigger event, the present invention implements a trigger into the MSC where the signal strength measurements are collected to transmit the measurements to the monitoring center when certain predefined criteria are detected. The criteria may include changes in the signal strength of the MS that exceed a defined threshold. The monitoring center may receive the information via User Service Signaling Data (USSD) or Short Message

Service (SMS) messages on the digital traffic channel (DTC) if the center is a mobile terminal or other terminal that has data messaging capabilities. A separate datalink may provide the monitoring center with the information in a printout if the center is not USSD or SMS capable, and an output device is defined for that center.

In the prior art, the MSC has information as to which cell the MS is in. The present invention utilizes changes in the attenuation of the signal strength to provide more accurate information within each cell. Signal strength measurements from the serving base station provide a circle of probable locations centered on the serving base station, since base station antennas are generally omnidirectional. If the signal strength increases, the MS is probably moving toward the base station. If the signal strength decreases, the MS is probably moving away from the base station. More accurate estimations of MS location can be made by also comparing signal strength measurements from neighboring cells. For example, if the signal strength from the serving base station is decreasing, then the MS is moving away from the serving base station. Concurrently, if the signal strength in a neighboring cell located to the east is increasing, then the MS is located on the east side of the serving base station. The monitoring agency may have maps which overlay the cell coverage areas over physical maps. In this way, if a main highway runs from one cell to another, a probable location on the main highway can be deduced.

The MSC may send the monitoring center only signal strength measurements between the MS and the serving base station. These measurements are available in the serving base station, and need only be retrieved by the MSC and sent to the monitoring center. In this case, the monitoring center would generally be able to deduce the mobile station's distance from the base station.

Signal strength information from adjacent cells is maintained in the MS until it requests a handoff. So ordinarily, this information is not shared. However at handoff, the MS provides measurements of serving cell and neighboring cell signal strengths to the MSC. In existing systems, the measurements are utilized only internally within the MSC to determine whether a handoff should be performed, and if so, to which cell. The signal strength information is not sent to other nodes. In the present invention, a monitoring function is added to the MSC in order to pass all signal strength information to the monitoring center. In order to retrieve adjacent-cell signal

strength information from the MS at times other than handoff requests, a new air interface signal is implemented between the MSC to the MS. The new signal triggers the MS to transmit the signal strength measurements from neighboring cells at times other than handoff requests. Alternatively, the MSC may send only serving cell signal strength measurements until handoff, at which time the measurements are supplemented with adjacent-cell signal strength information.

The signal strength measurements may be provided to the monitoring center continuously as the MSC receives them (for example, at MS registrations), periodically at a predetermined interval, or when triggered by certain triggering events such as large or rapid changes in the attenuation of the signal strength. For example, if the monitored MS is moving within the cell, and the signal strength changes by 5 dBm or 10 dBm from one reading to the next, this information is passed to the monitoring agency. This type of triggering event has been chosen because it provides the best indication of the MS's location within the cell without adding an additional processing load to the MSC. Other triggering events may also be utilized.

In the preferred embodiment, the signal strength measurements are provided to the monitoring center whenever the MS performs a periodic registration if the MS is not currently involved in a call. When the MS is involved in a call, the trigger event may be, for example, a change in the signal strength. For simplicity, an absolute signal strength measurement is always sent. Any calculations to be performed with the signal strength measurements can then be performed at the monitoring center.

If the monitoring center is a MS or any other terminal having data messaging capabilities such as USSD or SMS, the signal strength measurement or cell location may be provided to the monitoring center by data message over the DTC. Thus, if the monitoring center is a SMS-capable MS, they can monitor a conversation between mobile subscribers A and B while receiving the signal strength measurement information by SMS message on the same mobile terminal. The monitoring center may receive the information on a display rather than in a printout. In addition, the MSC collects signal strength information for the monitoring mobile terminal as well, and this information may be provided to the monitoring mobile terminal for purposes of comparison with the signal strengths of subscribers A and B. That is, the monitoring mobile terminal can compare its own signal strength from the serving base

station with the signal strength information for the monitored MSs involved in the call. Alternatively, the difference may be calculated in the MSC and sent to the monitoring mobile terminal. In some cells, a rough estimate of the proximity of the monitoring mobile terminal to the MSs in the call may be assessed based on the difference in signal strength.

Any call information that the MSC possesses about the call can be sent by SMS message or other means to the monitoring center. For example, the information provided to the monitoring center may include the monitored MS's cell location, signal strength between the serving base station and the monitored MS, identity of the subscribers in the call, date and time of the call, etc.

In addition to signal strength information, the monitoring agency may be interested in the monitored subscriber's categories. Categories which may be passed include features activated, current redirecting number, etc. In addition, the monitoring center may be notified when any changes are made to the subscriber's categories. Whenever the system operator changes a subscriber category in the subscriber's home location register (HLR), the monitoring center is notified. If the monitored MS is located in a visited MSC (V-MSC) which includes a visitor location register (VLR), the HLR sends a message to the VLR to change a temporary record whenever a change is made in the HLR. In this event, the HLR also sends a message to the monitoring agency notifying them of the changes that have been made.

The mobile subscriber can also utilize his MS to make changes to his categories in the HLR or the VLR. When the MS first enters the V-MSC, all of his categories are downloaded from the HLR to the VLR. At that time, all of the categories are sent to the monitoring center. From then on, only changes are sent. When the mobile subscriber utilizes his MS to make changes to his categories, the changes are first entered in the subscriber's temporary record in the VLR, and are then sent to the HLR to update the categories in the subscriber profile. At this time, a message is also sent by the V-MSC to the monitoring center notifying them of the changes that have been made. Thus, changes made in both the HLR and the VLR are reported.

The V-MSC sends the message to the monitoring center when the changes are made in the VLR. The V-MSC is the trigger point because it contains the temporary

information. The HLR is also a trigger point because it always contains all of the information as well as the changes. Changes made by the system operator are made in the HLR and then passed to the VLR. Changes made by the subscriber in the VLR are updated in the HLR.

FIG. 1 is a simplified block diagram of a cellular telecommunications network 10 in which the present invention has been implemented. A mobile station (MS) 11 is shown operating in Cell-1 (C1) having a base station 12. The base station is connected by means and methods known in the art to a visited mobile switching center (V-MSC) 13. The V-MSC is connected by signaling links to a visitor location register (VLR) 16 which stores temporary subscriber records for MSs visiting in the service area of the V-MSC. The VLR 16 is also connected to a home location register (HLR) 15.

A monitoring center 17, which may be fixed or mobile, is connected to each of the foregoing network nodes. Link 18 connects the monitoring center to the V-MSC 13. Link 20 connects the monitoring center to the HLR 15. Link 21 connects the monitoring center to the VLR 16. The link 18 between the V-MSC 13 and the monitoring center may be a datalink such as, for example, a x.25 datalink, or may be a USSD or SMS messaging link. In the preferred embodiment, if the monitoring center is USSD or SMS capable, the V-MSC and the monitoring center are connected by both a datalink, and either a digital control channel (DCCH) or a digital traffic channel (DTC) for carrying the USSD or SMS messages.

FIGS. 2A and 2B are a flow chart illustrating the steps of the preferred embodiment of the method of the present invention. At step 25, the MS to be monitored is identified to the network. The system operator then defines at 26 what information is to be sent to the monitoring center 17. The operator may indicate that only signal strength (SS) measurements are to be sent, only other call-related information is to be sent, or both. At step 27 it is indicated that signal strength information is to be sent. If signal strength information is to be sent, the method moves to step 28 where the serving base station reports to the V-MSC, signal strength measurements between the base station and the monitored MS.

The method then moves to step 29 where it is defined when the signal strength measurements are to be sent to the monitoring center. The measurements may be sent

periodically, continuously, or at triggering events. In a first alternative at step 31, it is defined that the measurements are to be sent periodically. The method then moves to step 32 where the MSC sends a cell ID for the serving cell and absolute signal strength measurements at predetermined intervals. In a second alternative, it may be defined at step 33 that the measurements are to be sent continuously (i.e., immediately whenever the MSC receives the measurements). The method then moves to step 34 where the MSC sends a cell ID for the serving cell and absolute signal strength measurements continuously (such as at periodic MS registrations) to the monitoring center as the measurements are received from the serving base station.

In a third alternative, it may be defined at step 35 that the measurements are to be sent to the monitoring center when predefined triggering events are detected. The predefined triggering events may include, for example, a change in the measured signal strength of more than a defined threshold such as 5 dBm. In this case, the method moves to step 36 where the MSC sends a cell ID for the serving cell and an initial absolute signal strength measurement when the monitoring is begun. Thereafter, when the MSC detects the triggering event at 37, the method moves to step 38 and sends updated signal strength information, as defined.

Alternatively, the predefined triggering events may be defined at 35 to include, for example, a handoff request by the monitored MS. At step 41, the MS requests a handoff and sends signal strength information from its serving cell and neighboring cells to the MSC. At step 42, the MSC sends all of the reported signal strength information to the monitoring center. From steps 32, 34, 38, or 42 the method moves to step 43 of FIG. 2B.

At step 43, it is determined whether or not the monitoring center is capable of receiving USSD or SMS messages. If the monitoring center is USSD or SMS capable, the method moves to step 44 where the signal strength information is sent in a USSD message or SMS Delivery Point-to-Point (SMDPP) message to the monitoring center. Additionally, at step 45, the signal strength information is sent over the datalink 18 (FIG. 1) to a printer or other defined output device at the monitoring center. If the monitoring center is not USSD or SMS capable, the method moves directly from step 43 to step 45 and sends the signal strength information over the datalink 18 to the printer or other defined output device at the monitoring center.

The method then moves to step 46 where it is determined whether other information is also being sent to the monitoring center. If not, the method ends at step 47. If signal strengths are being sent, the method returns to FIG. 2A, step 28. If subscriber categories are being sent, the method returns to FIG. 2A, step 61.

Referring again to FIG. 2A, the system operator may define, at step 26, that other call-related information is to be sent to the monitoring center. In this case, the method moves from step 26 directly to step 51. If both signal strength measurements and other call-related information are to be sent to the monitoring center, the method moves from step 27 to step 51. At step 51, the other call-related information may be defined as information maintained within the MSC such as the mobile identification number (MIN), the date and time of the call, the duration of the call, etc. The other call-related information may also be defined as information maintained within the HLR such as the identification of the subscriber, or other information from the subscriber profile such as the subscriber categories. For information maintained within the MSC, the method moves to FIG. 3.

FIG. 3 is a flow chart illustrating the steps of the method of the present invention when retrieving other call-related information from the MSC and sending the information to the monitoring center. At step 52, the MSC retrieves the defined call-related information from internal files. At 53, it is defined when the call-related information is to be sent. If it is defined that the call-related information is to be sent at the beginning of each call origination or termination in which the monitored MS is a party, the method moves to step 54. At step 55, the MSC sends a cell ID and the defined call-related information to the monitoring center at the beginning of each call origination or termination. If it is defined at 53 that the call-related information is to be sent at the end of each call origination or termination in which the monitored MS is a party, the method moves to step 56. At step 57, the MSC sends a cell ID and the defined call-related information to the monitoring center at the end of each call origination or termination. After step 55 or step 57, the method returns to FIG. 2B.

Referring again to FIG. 2A, the other call-related information may be defined at step 61 to include the subscriber categories. If so, the method moves to FIG. 4.

FIGS. 4A-4C are a flow chart illustrating the steps of the method of the present invention when retrieving subscriber categories and sending the subscriber categories

to the monitoring center. In FIG. 4A, the monitored subscriber is operating in the service area of V-MSC 13 (FIG. 1). At step 65, the system operator defines the monitored subscriber in the HLR 15. At 66, the HLR sends the initial subscriber categories to the monitoring center 17. Thereafter, changes to the subscriber categories may be made in the HLR by the system operator, or through the V-MSC/VLR 13 and 16 by the monitored subscriber. If a change is made in the HLR by the system operator at step 67, the method moves to step 68 where the HLR sends the changes to the monitoring center. If the subscriber utilizes his MS to change his categories through the V-MSC/VLR at 69, the method moves to step 70 where the VLR updates the HLR with the changes. At 71, the HLR sends the changes to the monitoring center. Following step 68 or step 71, the method returns to FIG. 2A.

In FIG. 4B, the monitored subscriber is operating in the service area of V-MSC 13, and the subscriber categories are sent to the monitoring center whenever the categories are changed. At step 75, the VLR 16 retrieves the subscriber categories from the HLR when the monitored subscriber roams in the V-MSC's service area. At 76, the VLR sends the initial subscriber categories to the monitoring center 17. Thereafter, changes to the subscriber categories may be made in the HLR by the system operator, or through the V-MSC 13 by the monitored subscriber. If a change is made in the HLR by the system operator at step 77, the method moves to step 78 where the HLR sends the changes to the VLR. At step 79, the VLR sends the changes to the monitoring center. If the subscriber utilizes his MS to change his categories through the V-MSC at 80, the method moves to step 81 where the V-MSC updates the VLR with the changes. At 82, the V-MSC sends the changes to the monitoring center. Following step 79 or step 82, the method returns to FIG. 2A.

In FIG. 4C, the monitored subscriber is operating in the service area of V-MSC 13, and the subscriber categories are sent to the monitoring center whenever the subscriber makes a call. At step 85, the V-MSC 13 retrieves the subscriber categories from the VLR 16 when the monitored subscriber makes a first call. At 86, the V-MSC stores the categories in a temporary record. At 87, the V-MSC sends the initial subscriber categories to the monitoring center 17. At 88, the V-MSC retrieves subsequent subscriber categories from the VLR whenever the monitored subscriber makes another call. At step 89, it is determined whether the subsequent subscriber

categories differ from the initial subscriber categories. If not, the method moves to step 90 and waits for the next call by the monitored subscriber. Following step 90, the method returns to FIG. 2A.

If there are changes in the subscriber categories at step 89, the method moves to step 91 where the V-MSC updates the subscriber categories in the temporary record. Finally, at step 92, the V-MSC sends the changes to the categories to the monitoring center. Following step 92, the method returns to FIG. 2A.

It is thus believed that the operation and construction of the present invention will be apparent from the foregoing description. While the method shown and described has been characterized as being preferred, it will be readily apparent that various changes and modifications could be made therein without departing from the spirit and scope of the invention as defined in the following claims.

WHAT IS CLAIMED IS:

1. A method of automatically providing to a monitoring center, signal strength measurements taken between a mobile station and a serving base station in a cellular telecommunications network, said method comprising the steps of:

measuring the signal strength between the mobile station and the serving base station;

sending the signal strength measurements from the serving base station to a mobile switching center (MSC); and

automatically sending the signal strength measurements from the MSC to the monitoring center at predetermined times.

2. The method of automatically providing signal strength measurements to a monitoring center of claim 1 wherein the step of automatically sending the signal strength measurements from the MSC to the monitoring center includes sending the signal strength measurements in a Short Message Service (SMS) message.

3. The method of automatically providing signal strength measurements to a monitoring center of claim 1 wherein the step of automatically sending the signal strength measurements from the MSC to the monitoring center at predetermined times includes sending the signal strength measurements continuously as the measurements are received at the MSC.

4. The method of automatically providing signal strength measurements to a monitoring center of claim 3 wherein the step of sending the signal strength measurements continuously includes sending the signal strength measurements whenever the mobile station performs a periodic registration.

5. The method of automatically providing signal strength measurements to a monitoring center of claim 1 wherein the step of automatically sending the signal strength measurements from the MSC to the monitoring center at predetermined times

includes periodically sending the signal strength measurements at a predetermined interval.

6. The method of automatically providing signal strength measurements to a monitoring center of claim 1 wherein the step of automatically sending the signal strength measurements from the MSC to the monitoring center at predetermined times includes sending the signal strength measurements when a triggering event is detected by the MSC.

7. The method of automatically providing signal strength measurements to a monitoring center of claim 5 wherein the step of sending the signal strength measurements when a triggering event is detected by the MSC includes sending the signal strength measurements when the signal strength from the mobile station changes by more than a threshold amount from an initial signal strength level.

8. The method of automatically providing signal strength measurements to a monitoring center of claim 5 wherein the step of sending the signal strength measurements when a triggering event is detected by the MSC includes sending the signal strength measurements whenever the mobile station requests a handoff.

9. The method of automatically providing signal strength measurements to a monitoring center of claim 1 wherein the mobile station collects signal strength measurements from the serving base station and a plurality of neighboring base stations (collectively, all the signal strength measurements), and the method further comprises, before the step of automatically sending the signal strength measurements from the MSC to the monitoring center, the step of sending all the signal strength measurements from the mobile station to the MSC.

10. The method of automatically providing signal strength measurements to a monitoring center of claim 9 wherein the step of automatically sending the signal strength measurements from the MSC to the monitoring center includes sending all the signal strength measurements from the MSC to the monitoring center whenever the

mobile station requests a handoff.

11. The method of automatically providing signal strength measurements to a monitoring center of claim 9 wherein the step of sending all the signal strength measurements from the mobile station to the MSC includes sending all the signal strength measurements from the mobile station to the MSC in response to a request for signal strength measurements by the MSC.

12. The method of automatically providing signal strength measurements to a monitoring center of claim 1 wherein the step of automatically sending the signal strength measurements from the MSC to the monitoring center includes sending the signal strength measurements on a datalink to an output device at the monitoring center.

13. The method of automatically providing signal strength measurements to a monitoring center of claim 12 wherein the step of automatically sending the signal strength measurements from the MSC to the monitoring center includes sending the signal strength measurements as a data message on a digital traffic channel.

14. A method of automatically providing information regarding a monitored mobile station and subscriber to a monitoring center in a cellular telecommunications network having a mobile switching center (MSC), a home location register (HLR) storing subscriber categories, a base station serving the monitored mobile station, and a plurality of neighboring base stations, said method comprising the steps of:

measuring signal strength measurements between the mobile station and the serving base station;

sending the signal strength measurements from the serving base station to the MSC;

storing call-related information in the MSC;

automatically sending the signal strength measurements from the MSC to the monitoring center at predetermined times; and

automatically sending the call-related information from the MSC to the monitoring center at predetermined times.

15. The method of automatically providing information regarding a monitored mobile station and subscriber to a monitoring center of claim 14 wherein the signal strength measurements and the call-related information are automatically sent from the MSC to the monitoring center during a call by the monitored mobile station.

16. The method of automatically providing information regarding a monitored mobile station and subscriber to a monitoring center of claim 15 wherein the step of automatically sending the call-related information from the MSC to the monitoring center includes sending the call-related information at the beginning of each call origination and termination by the mobile station.

17. The method of automatically providing information regarding a monitored mobile station and subscriber to a monitoring center of claim 15 wherein the step of automatically sending the call-related information from the MSC to the monitoring center includes sending the call-related information at the end of each call origination and termination by the mobile station.

18. The method of automatically providing information regarding a monitored mobile station and subscriber to a monitoring center of claim 15 further comprising automatically sending subscriber categories for the monitored subscriber from the HLR to the monitoring center at predetermined times.

19. The method of automatically providing information regarding a monitored mobile station and subscriber to a monitoring center of claim 18 wherein the step of automatically sending the subscriber categories from the HLR to the monitoring center includes the steps of:

sending initial subscriber categories to the monitoring center when the monitoring center begins monitoring the mobile station; and

sending changes to the subscriber categories to the monitoring center whenever the categories are changed.

20. The method of automatically providing information regarding a monitored mobile station and subscriber to a monitoring center of claim 15 wherein the cellular telecommunications network also includes a visitor location register (VLR), and the method further comprises the steps of:

retrieving by the MSC, the subscriber categories from the VLR; and

automatically sending the subscriber categories from the MSC to the monitoring center whenever the monitored mobile station makes a call.

21. The method of automatically providing information regarding a monitored mobile station and subscriber to a monitoring center of claim 15 wherein the cellular telecommunications network also includes a visitor location register (VLR), and the method further comprises the steps of:

retrieving by the VLR, initial subscriber categories from the HLR when the MS roams into an area served by the VLR; and

automatically sending the initial subscriber categories from the VLR to the monitoring center.

22. The method of automatically providing information regarding a monitored mobile station and subscriber to a monitoring center of claim 15 wherein the cellular telecommunications network also includes a visitor location register (VLR), and the method further comprises the steps of:

retrieving by the MSC, initial subscriber categories from the VLR when the monitored mobile station makes a first call;

sending by the MSC, the initial subscriber categories to the monitoring center;

retrieving by the MSC, subsequent subscriber categories from the VLR when the monitored mobile station makes a second call;

determining whether the subsequent subscriber categories differ from the initial subscriber categories; and

sending by the MSC, changes to the subscriber categories to the monitoring

center upon determining that the subsequent subscriber categories differ from the initial subscriber categories.

23. A method of automatically providing information regarding a monitored mobile station and subscriber to a monitoring center in a cellular telecommunications network having a mobile switching center (MSC), a home location register (HLR), a base station serving the monitored mobile station, and a plurality of neighboring base stations, said method comprising the steps of:

measuring in the serving base station, signal strength measurements between the mobile station and the serving base station;

collecting in the mobile station, signal strength measurements between the mobile station and the plurality of neighboring base stations;

sending the signal strength measurements between the mobile station and the serving base station, and between the mobile station and the plurality of neighboring base stations to the MSC;

storing call-related information in the MSC;

automatically sending the signal strength measurements from the MSC to the monitoring center at predetermined times during a call by the mobile station;

automatically sending the call-related information from the MSC to the monitoring center at predetermined times during the call; and

automatically sending subscriber categories from the HLR to the monitoring center at predetermined times.

FIG. 1

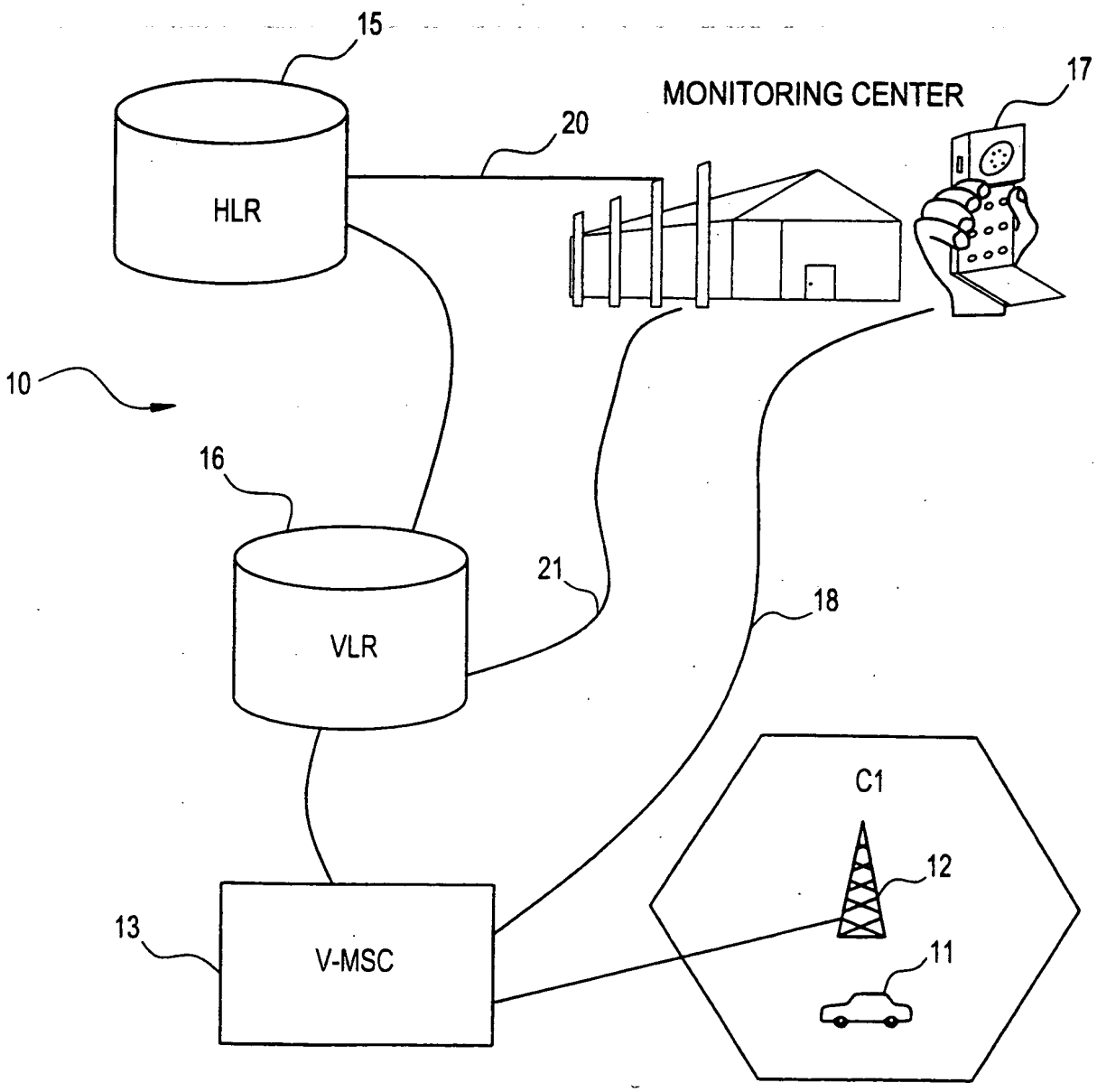


FIG. 2A

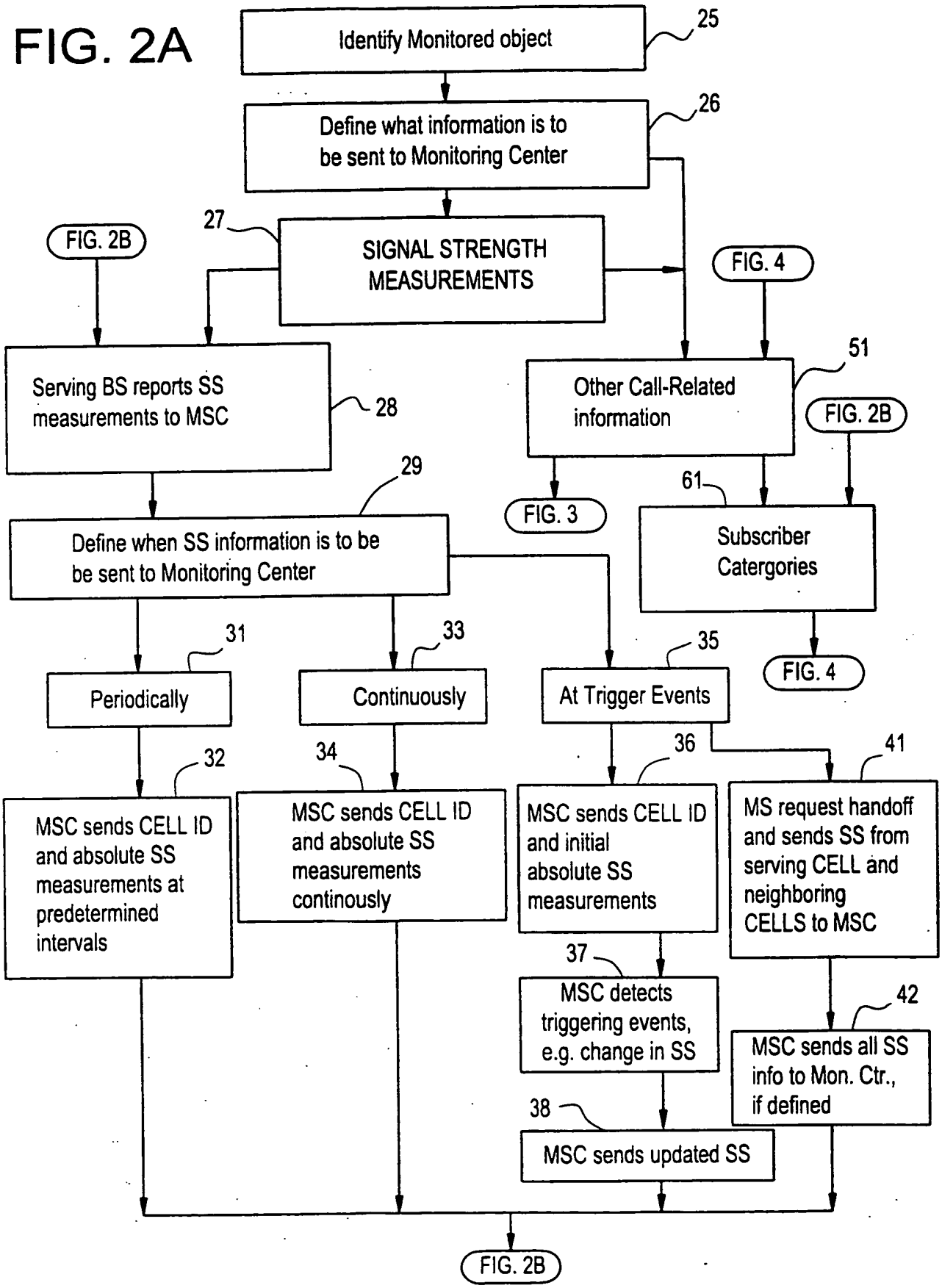

Identify Monitored object
25
Define what information is to be sent to Monitoring Center
26
27
SIGNAL STRENGTH MEASUREMENTS
FIG. 2B
FIG. 4
Serving BS reports SS measurements to MSC
28
Other Call-Related information
51
FIG. 2B
29
61
FIG. 3
Subscriber Catergories
Define when SS information is to be be sent to Monitoring Center
31
33
35
FIG. 4
Periodically
Continuously
At Trigger Events
32
34
36
41
MSC sends CELL ID and absolute SS measurements at predetermined intervals
MSC sends CELL ID and absolute SS measurements continously
MSC sends CELL ID and initial absolute SS measurements
MS request handoff and sends SS from serving CELL and neighboring CELLS to MSC
37
42
MSC detects triggering events, e.g. change in SS
MSC sends all SS info to Mon. Ctr., if defined
38
MSC sends updated SS
FIG. 2B

FIG. 2B

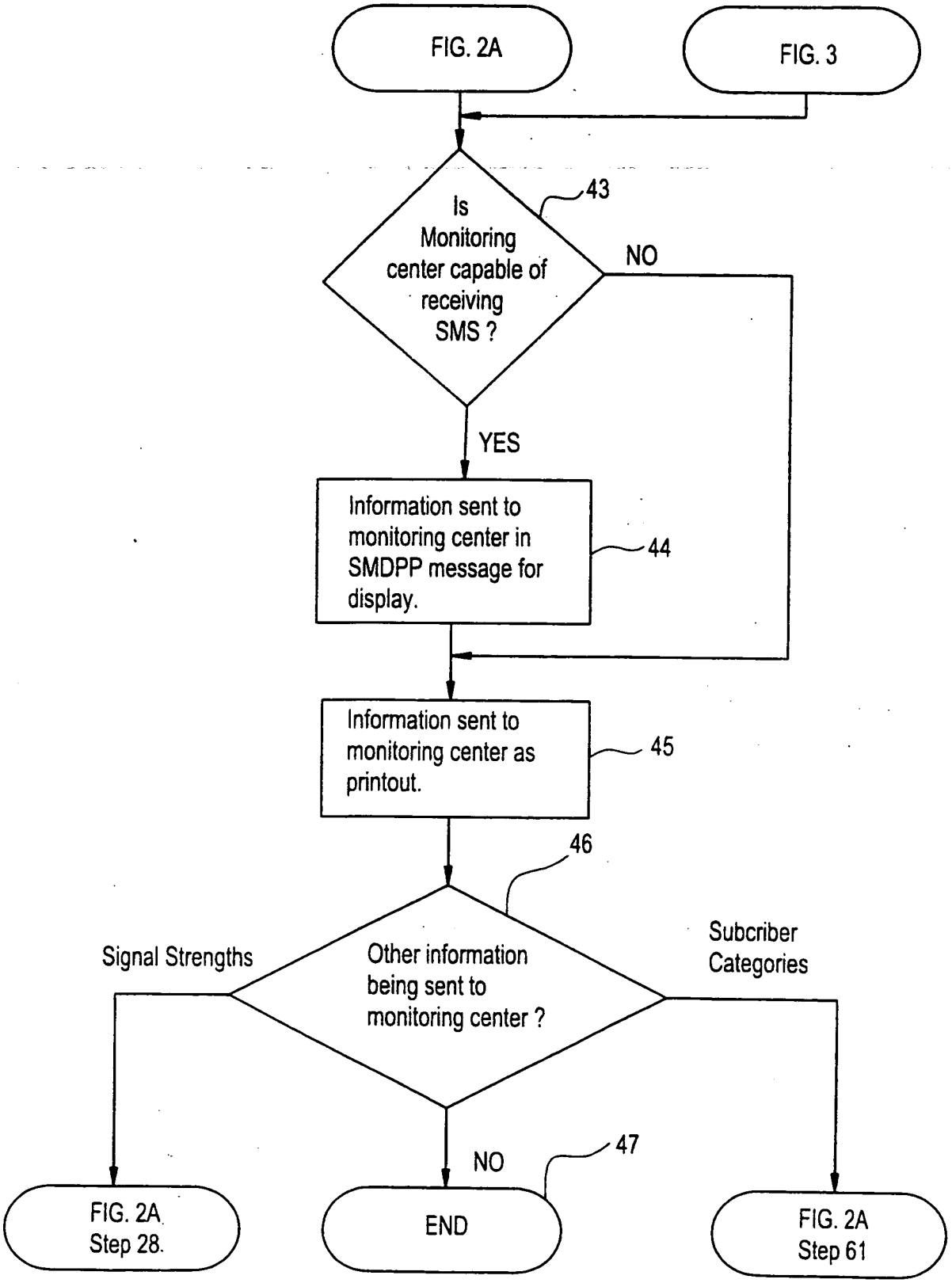


FIG. 2A
FIG. 3
Is Monitoring center capable of receiving SMS ?
43
NO
YES
Information sent to monitoring center in SMDPP message for display.
44
Information sent to monitoring center as printout.
45
46
Other information being sent to monitoring center ?
Signal Strengths
Subcriber Categories
NO
47
FIG. 2A Step 28.
END
FIG. 2A Step 61

FIG. 3

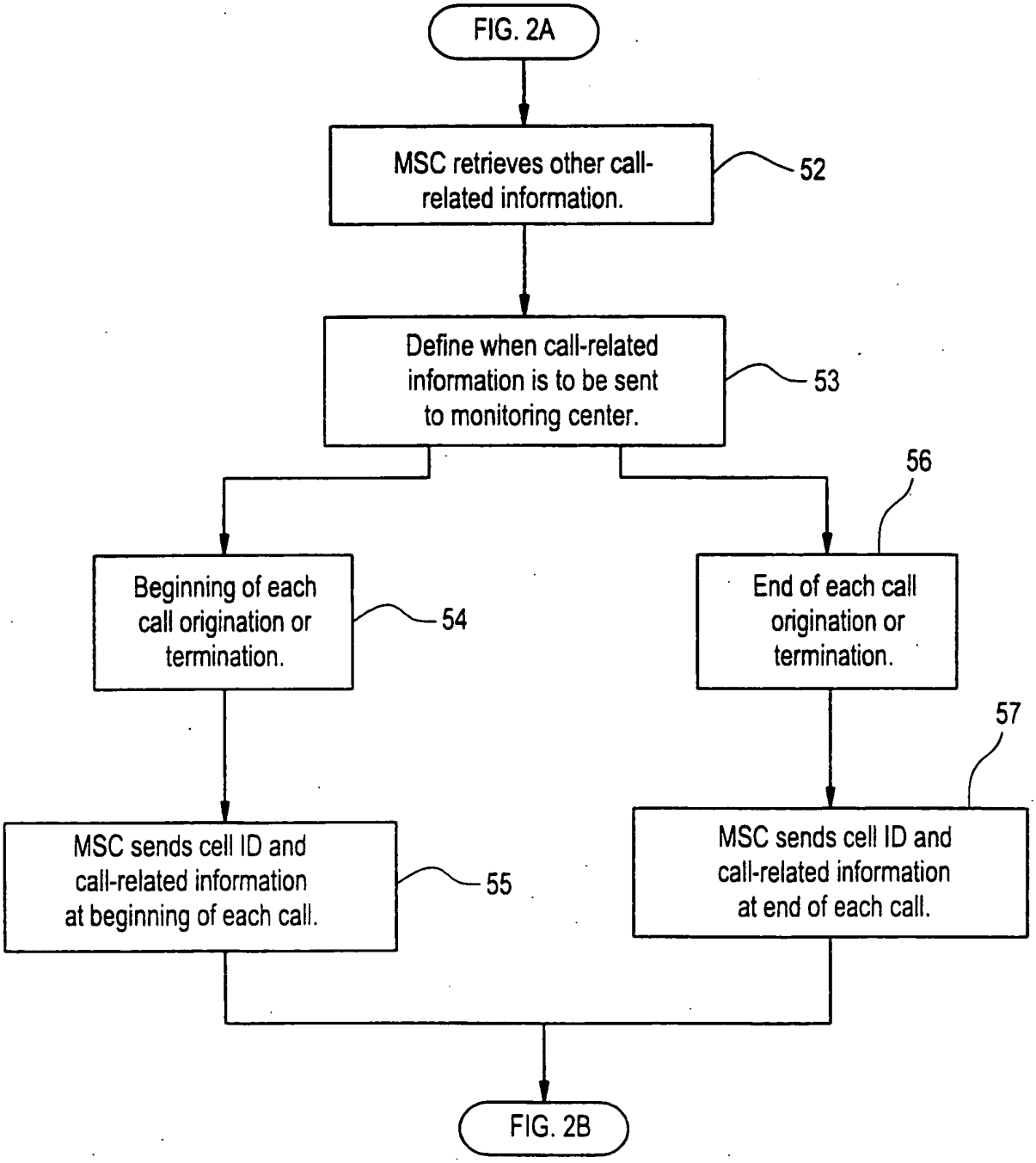


FIG. 2A
MSC retrieves other call-related information.
52
Define when call-related information is to be sent to monitoring center.
53
56
Beginning of each call origination or termination.
54
End of each call origination or termination.
57
MSC sends cell ID and call-related information at beginning of each call.
55
MSC sends cell ID and call-related information at end of each call.
FIG. 2B

FIG. 4A

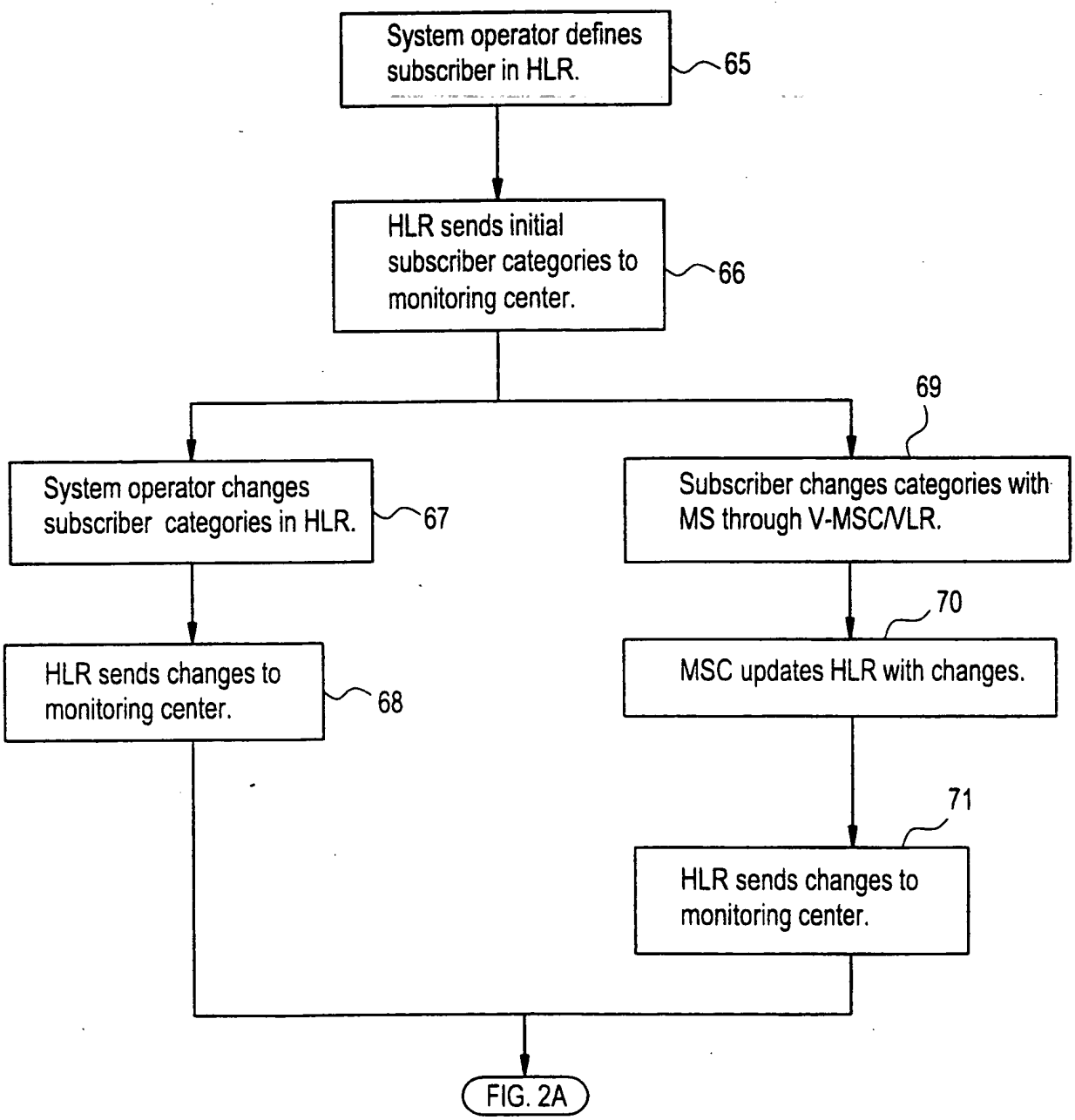

System operator defines subscriber in HLR.
65
HLR sends initial subscriber categories to monitoring center.
66
69
System operator changes subscriber categories in HLR.
67
Subscriber changes categories with MS through V-MSC/VLR.
70
HLR sends changes to monitoring center.
68
MSC updates HLR with changes.
71
HLR sends changes to monitoring center.
FIG. 2A

FIG. 4B

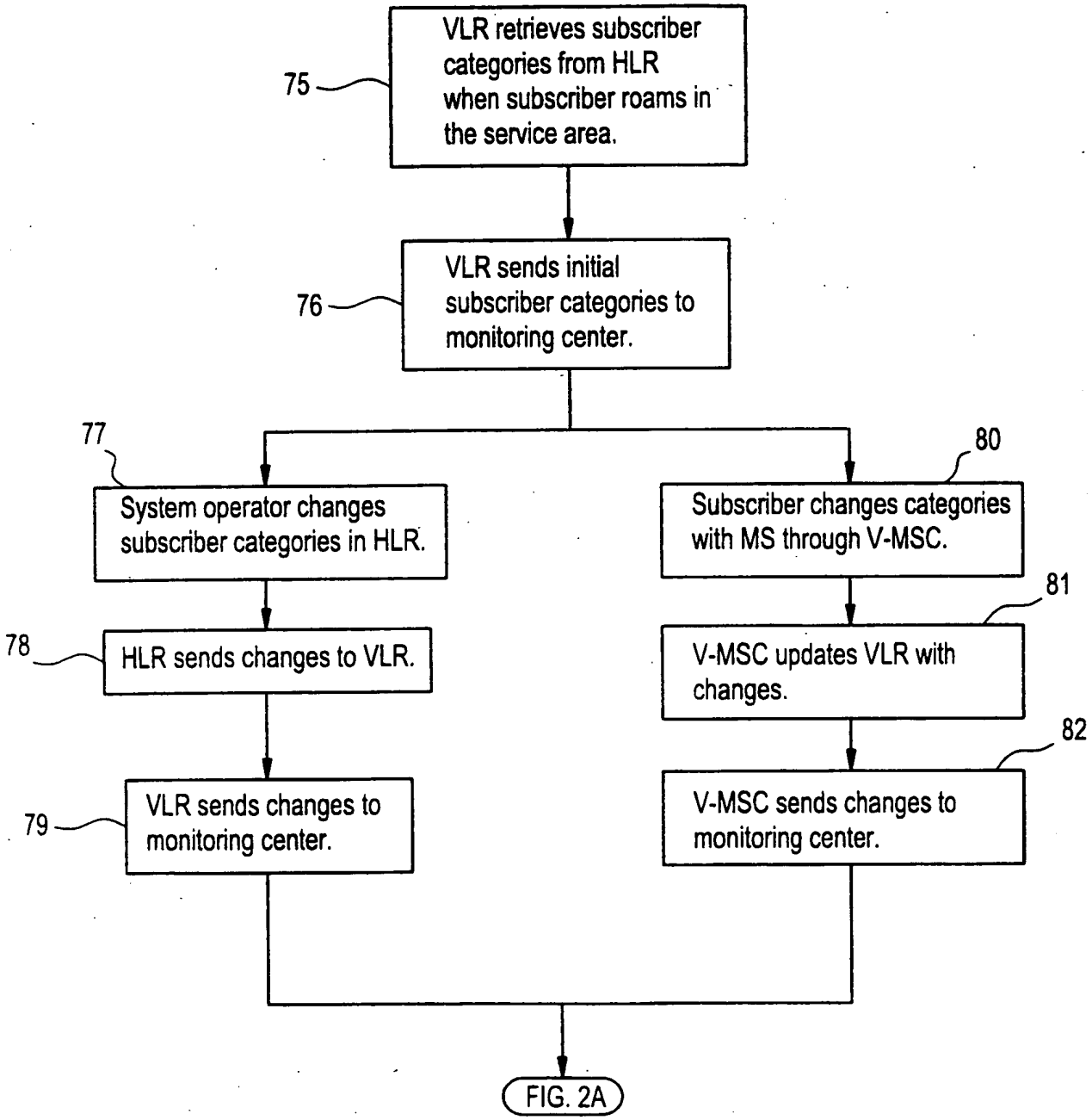
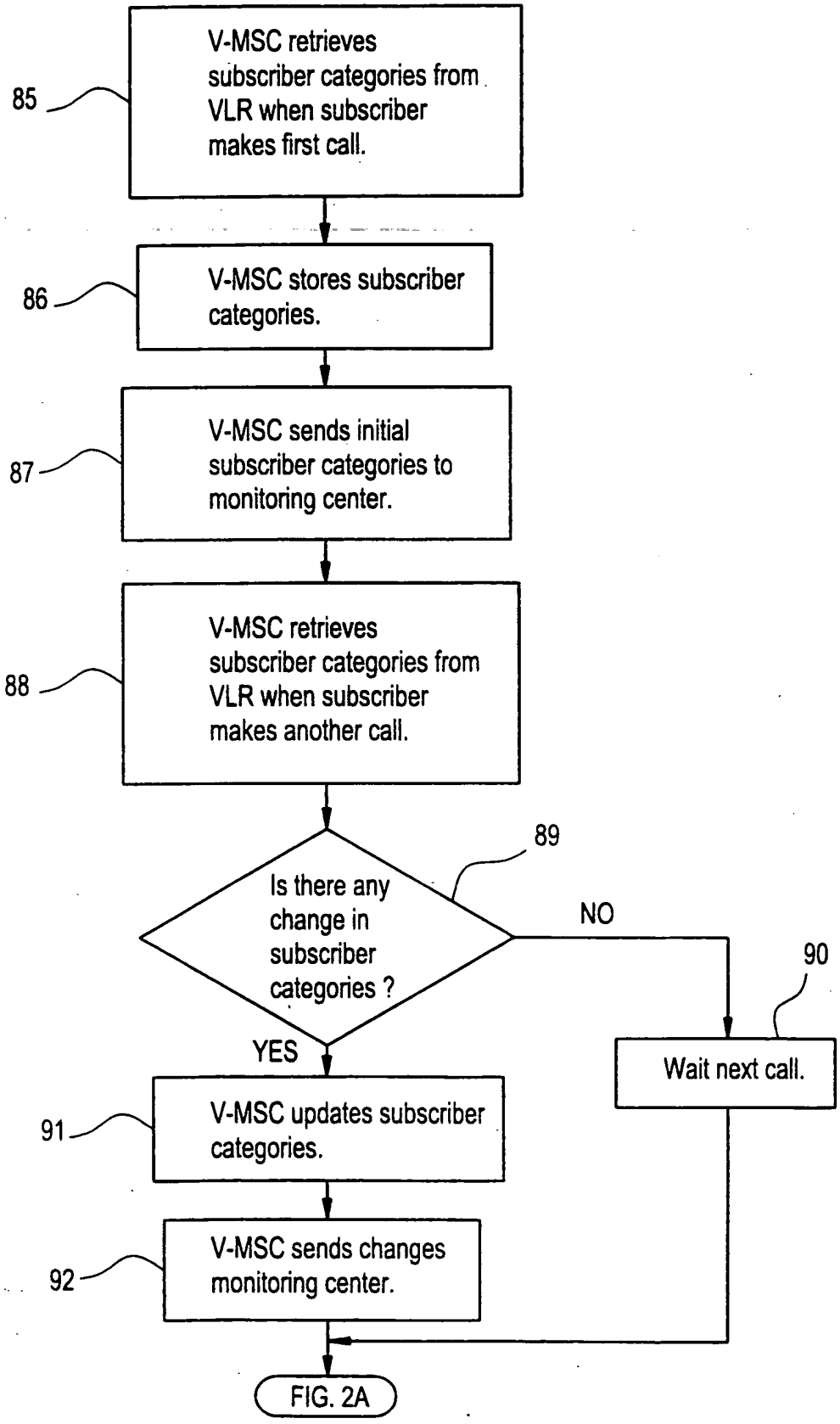

VLR retrieves subscriber categories from HLR when subscriber roams in the service area.
75
VLR sends initial subscriber categories to monitoring center.
76
77
System operator changes subscriber categories in HLR.
80
Subscriber changes categories with MS through V-MSC.
78
HLR sends changes to VLR.
81
V-MSC updates VLR with changes.
79
VLR sends changes to monitoring center.
82
V-MSC sends changes to monitoring center.
FIG. 2A

FIG. 4C


V-MSC retrieves subscriber categories from VLR when subscriber makes first call.
85
V-MSC stores subscriber categories.
86
V-MSC sends initial subscriber categories to monitoring center.
87
V-MSC retrieves subscriber categories from VLR when subscriber makes another call.
88
Is there any change in subscriber categories ?
89
NO
YES
Wait next call.
90
V-MSC updates subscriber categories.
91
V-MSC sends changes monitoring center.
92
FIG. 2A

INTERNATIONAL SEARCH REPORT

Int[redacted]l Application No
PCT[redacted] 99/00926

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 724 660 A (KAUSER NICOLAS ET AL) 3 March 1998 (1998-03-03) column 4, line 17 -column 6, line 23 figure 2	1,6,9, 14,15
A	WO 98 27714 A (ERICSSON GE MOBILE INC) 25 June 1998 (1998-06-25) page 2, line 14 - line 32 page 5, line 15 -page 6, line 19 page 7, line 25 - line 37	1,2,23
A	WO 98 00988 A (ERICSSON GE MOBILE INC) 8 January 1998 (1998-01-08) page 16, line 14 -page 17, line 6 page 19, line 9 -page 23, line 7	1-23

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 October 1999	08/10/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Pecci, R

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/SE 99/00926

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		BR 9701024 A	03-11-1998
		CA 2195591 A	21-08-1997
WO 9827714 A	25-06-1998	AU 5597598 A	15-07-1998
WO 9800988 A	08-01-1998	AU 3592797 A	21-01-1998